

SUPPLEMENT TO THE MYSORE GAZETTE.

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Published by Authority.

BANGALORE, SATURDAY 3RD AUGUST 1867.

MISCELLANEOUS PAPERS.

REPORT OF CHINCHONA COMMISSION.

From the President and Members of the Chinchona Commission, to the Secretary to Government, Revenue Department, Fort Saint George, dated Madras 28th February 1867.

1. With reference to the Order of Government, as per margin, we have the honor to report that the printing of the tabulated results of the experimental use of Chinchona alkaloids has occasioned some delay in the submission of a progress report. A considerable number of the tables, however, have now been printed, so as to enable us to estimate, with tolerable precision, the therapeutical effects of the several alkaloids; and, as our President will have no other opportunity of recording his views as to the usefulness of these medicines, the Members of the Commission have decided to conclude now a preliminary report of their proceedings, leaving their more detailed observations to follow when the results of the experiments still in progress are more fully known.

2. In the tabular statements, already printed and laid before the Commission, minute particulars in regard to 1,145 cases of paroxysmal fevers treated either by Chinchonine, Chinchonidine, or Quinidine, have been registered. These fevers have occurred mostly at stations notably malarious, such as at Goodaloor in the Wynaad; Sumblepoor and Russelcondah in the Northern Circars; the Godavery jungles; Mysore, Cochin, and Labuar, and may, therefore, be regarded

as fair average types of the forms of paroxysmal fever to be met with in the malarious districts of Southern India.

3. A larger number of cases have been treated up to date, but the Returns have not yet been received, or, if received, are not out of the printer's hands, so that the results must be considered in detail hereafter.

4. With regard to the 1,145 cases of fever referred to, it will suffice to note that they were treated by the alkaloids, as follows:—

By sulphate of Chinchonine	..	410
Do. Chinchonidine	..	359
Do. Quinidine	..	376

The doses and mode of administration varied a good deal. Some Medical Officers used large doses of from 15 to 20 grains; others, medium doses of from 8 to 10 grains; and some, small doses of from 2 to 5 grains. As a general rule, the Members of the Commission are of opinion that the experiments were most successful when medium doses were employed, that is, the cases of fever in which 8 or 10 grains of alkaloid were administered in a single dose daily, appeared to recover more expeditiously than where larger or smaller quantities were employed. Large doses of Chinchonine, Chinchonidine, and Quinidine produce effects very similar to those of Quinine. Disagreeable noises in the head, singing in the ears, deafness, and giddiness are the more noticeable of the symptoms produced by all of the Chinchona alkaloids. Vomiting, nausea, and purging also are occasionally noted to follow their use. On the other hand, small or moderate doses produce none of these peculiar effects, while they improve the appetite, strengthen the digestion, and, in many cases, appear to have a marked effect in reducing the size of congested spleens.

5. The alkaloids were exhibited successfully, that is, with the result of a rapid cessation of febrile paroxysms in a very large proportion of the cases. Out of the 1,145 cases recorded, four deaths occurred, and all these took place at Goodaloor, in Wynaad. Dr. Keess observes of them, that the fever was complicated either with Pneumonia or Diarrhœa, and that a great proportion of his patients were half-starved, emaciated persons, completely prostrated by the malarious influences surrounding them.

In addition to the cases ending fatally, it is recorded that the alkaloids failed more or less to arrest febrile paroxysms in twenty-seven persons—a proportion a little in excess of two per cent of the total cases treated.

6. In regard to these failures, it must be noted that they occurred chiefly in the practice of gentlemen who tried the alkaloids, not in recent attacks of fever, but in patients whose systems were chronically poisoned by malaria. Thus, Mr. Walters, of the 4th Regiment N. I., Secunderabad, records of many of his cases, that they had been from one to three or four months suffering from fever before he used the alkaloids, and that in some of them Quinine failed just as much as Quinidine, Chinchonine, or Chinchonidine had done. Mr. Chipperfield explains the probable cause of failure in his Report (Appendix III). In recent attacks of uncomplicated paroxysmal fever, the new alkaloids appeared to most of the Medical Officers using them, and to the Members of the Commission, to be quite as efficacious in the curing of fevers, as Quinine. On this subject, however, it is impossible to speak with precision, until the results of treatment with the chemically pure di-sulphate of Quinine, as supplied by Messrs Howards, have been tabulated in the form used for recording the treatment by the other alkaloids. Instructions have been issued to the gentlemen engaged in the experiment to do this, and the returns, when received, will afford most valuable data whereby to compare the relative therapeutical effects of the several alkaloids.

7. The evidence, so far as it has come before the Commission, does not go to show any particular superiority of one alkaloid over another.

The sulphate of Quinidine is, perhaps the one regarding which there is the least difference of opinion as to its merits. All three are undoubtedly anti-periodic, and capable of controlling paroxysmal fevers. The sulphate of Chinchonine in large doses perhaps causes more unpleasant symptoms than the others; but on this point further evidence is still wanting to enable the Commission to offer a positive opinion. As re-

gards the general and practical question at issue, we agree with Dr. Keess in thinking that all three alkaloids are, equally with Quinine, capable of controlling paroxysmal fevers. Dr. Keess's experience led him to conclude that a 10 grain dose of either salt, would check or postpone the febrile paroxysm in a considerable number of cases, while very few patients required more than a second 10 grain dose to subdue the disease for the time being.

Other observers have employed larger quantities of the several drugs; but it is by no means clear to the Commission, that the quantities exhibited were, in all cases, necessary to check the fever. As regards this part of the inquiry it is intended to institute a distinct series of experiments for the more accurate comparison of the value of the several alkaloids when contrasted with Quinine, or with each other.

8. The main conclusion which the Members of the Commission have derived from the data before them, is that the alkaloids hitherto but little valued in medicine, are scarcely, if at all, inferior as therapeutical agents to Quinine.

What the exact differences may be in their physiological and therapeutical action, is a question the answering of which may fitly be deferred until more data have been collected in reference to the new alkaloids. The differences, however, will most likely be found to be of degree, rather than of kind, and practically, so far as the wants of India are concerned, it will be just as well that the locally grown barks yield a large proportion of one alkaloid as of another.

9. So impressed are we of the value of these hitherto despised alkaloids that the Members of the Commission are unanimous in considering that, in the public service of this country, they may very advantageously be substituted in part for Quinine. If three pounds of Chinchonine can be obtained at the price of one pound of Quinine, we consider that a great public good would result from the purchase of the larger quantity, as it would enable the Officers of the Medical Department to benefit a much larger number of the population than they can now afford to treat by prescribing Quinine. Arrangements will be made, by Dr. Mackenzie to include in the next Medical Indent on the Home Government a requisition for suitable quantities of each alkaloid.

Report on the Chinchona Alkaloids.

1. In obedience to instructions received from the Head of the Medical Department, I proceeded to

Goodaloor, South East Wynaad, and started the alkaloids experiment on the 1st June 1866.

2. When I arrived at Goodaloor, fever was prevailing to a great extent, both there and in the adjoining coffee estates. Owing to the great rush of fever subjects to the Dispensary, I decided on first observing the effects of large doses of the alkaloids.

3. As there were many persons suffering from fever in June, the administration of a single large dose enabled me to take up a larger number of cases, than I would have been able to do, had I begun with small and repeated doses.

4. I first tried Chinchonidine, in doses varying from 10 to 15 grains, and, in a few days, I was pleased to find that it acted as Quinine would have done in similar doses.

5. I next tried Quinidine with similar results.

6. I left Chinchonine to the last, as it was said to be an irritant of the gastro-intestinal mucous surface. I was, however, agreeably disappointed, when I found that it did not cause nausea or vomiting in doses of 10 grains, and that it was as good an anti-periodic as the sister alkaloids.

7. Encouraged by the absence of symptoms indicating gastro-intestinal irritation, I used Chinchonine in fever complicated with diarrhoea, and I am satisfied that it is not an irritant of the stomach or bowels any more than Quinine is, in certain cases.

8. Some of my patients were *out* and *in*-patients of the Goodaloor Dispensary. Others were visited in the bazaar, and in the adjoining coffee estates, from two to six miles distant from Goodaloor.

9. The great majority of my patients were half-starved, emaciated persons, with flabby muscles, dry, dirty, and shrivelled skins, large spleens, bloodless eyes, and tongue, and small atonic pulse. In many of them, languor was so marked that they could, with difficulty, muster up energy enough to reply to questions; and so prostrated were some of them, that they were, with difficulty, induced to take the medicines offered to them.

10. I have not attempted to reduce, to a small compass, the results set forth in the tabular reports, as I hear that this work has been undertaken by the Chinchona Commission; but I beg leave to point out that a 10-grain dose, of all three alkaloids, seemed sufficient to check the return of fever in the majority of cases. Where it failed to check the return of fever, the succeeding paroxysm was generally observed to be less severe. When the paroxysms returned with unabated severity, 15 grains, and then 20 grains were tried. In

a few severe cases, I administered, at the onset, 15 or 20 grains. 535

11. During the four months that I was employed in the Wynaad, 467 cases were treated with the alkaloids. The majority of these were cases of the quotidian type. Bronchitis, congestion of lungs, pneumonia, diarrhoea, dysentery, and anasarca were occasional complications. I may as well add, that these complications did not in the least interfere with the administration of the alkaloids. Where the local affection required special attention, the alkaloids were given with remedies suitable to the complication. I may here add that all three alkaloids appeared to be as efficacious as quinine.

* * * * *

(Signed) J. KEESS, M. D., Asst. Surgeon,
Late on special duty in the Wynaad.
MADRAS, 25th February 1867.

*Report on the therapeutic effects of the salts of the
Chinchona Alkaloids.*

1. In furnishing the accompanying tabular reports, of the therapeutic effects of the Chinchona Alkaloids, as tested at the General Hospital Madras, I have the honor to state, that in order, to draw a more accurate comparison between the salts tested and the di-sulphate of Quinine, I exhibited the former in the same way as I am in the habit of using the latter, viz., I gave the first dose upon the decline of the sweating stage, the second and third doses being given at two-hour intervals. The fourth dose was exhibited at the same hour as the first dose, and so on with the fifth, sixth, and any subsequent doses which appeared to be required.

2. I have been led to form a high estimate of the anti-periodic effects of the sulphate of Quinine. This salt was successful in the cure of the eight cases in which it was administered, and it appeared to me to be quite as valuable a remedy as the di-sulphate of Quinine itself. In some respects it seemed superior to Quinine, as in no instance did it produce any of the disagreeable effects termed Chinchonism; in fact, two patients who were suffering from severe headache, stated that the medicine completely relieved this symptom. I did not observe any injurious effects upon the digestive organs, but rather a favorable action, as appetite was promoted and digestion apparently assisted. In seven cases the Quinine was given in doses of five grains thrice daily. As these doses were effectual, I continued them. But, as a matter of experiment, in case 8, I gave on the 11th of June one dose of 15

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grains on the decline of the sweating stage, and a second dose of 8 grains two hours before the next expected paroxysm. The patient was free from fever for five days, when a relapse occurred. The same plan of administration was followed and with success, for there was no further paroxysm of ague, although the patient remained under observation for incipient Phthisis, for a period of more than a month.

3. The sulphate of Chinchonine I would place second on the list as an anti-periodic. It was unsuccessful in three out of eleven cases; but two of these were very unfavorable ones. One, a European Coffee Planter, was suffering from Tœnia and general abdominal engorgement, and the remedy could not be pushed in his case, as it produced Chinchonism very rapidly. He had taken a large quantity of Quinine before the Chinchonine was commenced. He was subsequently treated with Pernitrate of Iron, Kuosso, Turpentine and oil of Male Fern, but he did not pass the head or neck of the Tœnia, only a few proglottides. I saw him on September 17th very much improved in health, getting strong and stout, and quite free from fever. The second case, a European (Surgeon of the ship "Blackwall,") was a relapse. Three weeks previously he had been cured of an intermittent by Quinidine. (Case 7 in the table.) He was then suffering from Chronic Hepatitis, and had threatenings of Hemiplegia. These symptoms quite disappeared before his first discharge from Hospital on the 19th June. On his second admission it was ascertained that he had been much exposed to the sun, going forwards and backwards among the shipping in the roads. The *Chinchonine failed to arrest the paroxysms of ague, which was subsequently effected by Quinine.

4. The third unsuccessful case was that of a Eurasian lad, whose stomach would not tolerate the remedy. He was subsequently cured by a combination of Diaphoretics with Quinine.

5. Gastric disturbance was produced by the Chinchonine in most of the successful cases.

6. The sulphate of Chinchonidine appears to me a much inferior anti-periodic to Quinine. It was unsuccessful in five out of twelve cases in which it was employed. I allowed myself to be somewhat prejudiced against the salt when I commenced its use, as it almost always produced nausea.

7. In cases 1, 8, and 9, it was decidedly successful. Case 2 might be removed from the table; the man was saturated with malaria, and had previously been treated by Quinine and by Chinchonine.

8. Case 3 was a complicated one; the woman was the subject of Hysteria, and each cold stage was accompanied by violent hysterical fits. Her spleen was much enlarged, and altogether, it was a most unfavorable case for even Quinine. Deobstruents were freely used, even whilst taking the Chinchonidine. She is entered as having been successfully treated by the Chinchonine (Case No. 10 in the table). The fact is, there had been no paroxysm for two or three days whilst taking the Chinchonine, and as that salt was exhausted, she simply passed to the Chinchonidine. She has since had relapses, and has been treated by Quinine and Deobstruents. She was discharged at her own request on the 31st August, but since then has had a relapse and has again come under treatment.

9. Case 4 might be removed from the table; he had only one dose of Chinchonidine which increased mental delusion as Quinine had done before. He is still under treatment, occasionally getting a paroxysm of ague with very profuse sweating. He is improving under mineral acids, and his distressing mental delusions have disappeared.

10. In case 5, the remedy produced violent vomiting, and it was discontinued at the patient's request. The same remark may be made as to case 6, subsequently cured by Quinine. Cases 7 and 12 were very mild cases, which would probably have been easily cured without any Chinchona preparation. In case 10, nine grains of Chinchonidine appeared to prevent the recurrence of a paroxysm. The patient, a very anæmic female, was subsequently cured by ferruginous remedies.

(Signed) W. N. CHIPPERFIELD,

Assistant Surgeon,

Acting Physician, General Hospital.

MADRAS.

18th September 1866.

From the Inspector General, Medical Department, to the Secretary to Government, Revenue Department, dated, Fort St. George, 29th March 1867, No. 84.

1. In continuation of this Office letter, No. 372 of the 11th October 1866, I have the honor to forward for submission to the Home Government, a copy of each of the tabulated reports, received printed since that date, of the therapeutic effects of the Chinchona alkaloids received from England for experimental trial.

2. The report and tabulated statistics, received up to the end of February by the Chinchona Commission, have already been submitted to Government.

* Only Zs. s. given.

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From J. Broughton, Esq., Quinologist to Government
to the Secretary to Government, Revenue Depart-
ment, Fort Saint George, dated Ootacamund, 2nd
April 1867:—

2. I would request permission to proceed on duty to Madras on the arrival of the Government vessel containing my laboratory stores, in order to superintend personally the transit of the same to this place. Any damage to the apparatus would seriously impede my future work.

1. I have the honor, in the subsequent pages, of submitting such part of the results of my examination of the various products of the Government, Chinchona plantations, that possess sufficient interest and definitiveness to be brought under the notice of Government.

requisite for the analysis of Chinchona barks. Notwithstanding the kind assistance I have received from Mr. McIvor and Mr. Batcock on all occasions when the establishment at the Botanic Gardens could supply my wants, much time has been consumed in improvising substitutes for lacking implements, and in making such arrangements as are incident to a new establishment.

4. A slight inspection of the more advanced portions of the plantations at Neddivuttum reveals considerable differences in the habit and appearances of the individual Red Bark trees. This has already been remarked by Mr. C. R. Markham, who suggested that these variations in the coloring and habit of the trees might probably be connected with differences in their yield of alkaloids. The accuracy of this conjecture is rendered evident by the results of the analyses of the trunk bark of four trees, which are calculated in percentages of dry bark, as given below :—

Statement of Analyses.

	I.	II.	III.	IV.
Total alkaloids (hydrated) ...	4.85	7.00	6.40	6.4
Alkaloid soluble in Ether (Quinine) ...	3.25	4.25	4.75	1.7
Chinchonidine and Chinchonine.	1.60	2.75	1.65	4.7
Sulphate of Quinine obtained crystallized ...	3.00	4.00	4.55	1.7

In the above analyses, as well as those given subsequently, the sulphate of Quinine has been obtained in as pure a state as possible.

5. Of No. I., it may be remarked that though the poorest specimen that has come under my notice, it gives at least an equal yield to the best Ecuador Red Barks. Nos. II., III., and IV. are considerably richer. Seven per cent of alkaloids in the natural (unmossed) bark appeared to me so large an amount that I was led to repeat the analyses by a different method, which, however, closely corroborated the former results. No. II. owes its richness in alkaloids to the presence of an unusually large amount of Chinchonine, which crystallized from an alcoholic solution with the greatest readiness. No. IV. contained comparatively but a small amount of Quinine, but in its stead a large amount of Chinchonidine, which easily yielded a sulphate not distinguishable by the eye from that of Quinine. In this sample of bark the total quantity of crystalline sulphates obtained was no less than 5.2 per cent of the weight of the dry bark. All the barks contain a certain amount of Quinine apparently not susceptible of crystallization.

6. These analyses were made in all cases with the bark of the trunk, which (doubtless on account of superior age) is much richer than that of the branches yielding "quill bark." Some of the latter, which I examined, yielded but three per cent of alkaloids, from which 1.4 per cent of crystalline sulphates was obtained.

I am of opinion that the foregoing data, compared with those of Mr. Howard's earlier reports, afford grounds for believing that the amount of alkaloids in the barks is still on the increase.

7. It should be stated that the richness of the Red Barks in the alkaloids, though doubtless entitling them to the first place among our Indian barks, is not, in many respects, a true measure of their intrinsic value for manufacturing purposes. This value depends also on the readiness with which the Quinine, &c., can be obtained in a pure and crystalline form. In this respect the natural unmossed *Succirubra* bark is at some disadvantage, since its alkaloids are more difficult to obtain in a pure form than those yielded by some other kinds.

8. Mr. McIvor's valuable and interesting method

Mossed Red Bark.

of treatment of the barks by mossing as already been fully described by himself. Unfortunately I was unable to obtain a specimen of bark that had been under this treatment for more than six months. A sample of bark of a tree of four years and a half old, renewed under moss, yielded (in per centages of dry bark) :—

Analyses of mossed renewed Bark.	Total alkaloids (hydrated) ... 7.10 per cent
	Alkaloids soluble in Ether (Quinine ... 3.95 " "
	Chinchonine and Chinchonidine ... 3.15 " "
	Crystallized sulphate of Quinine obtained ... 3.45 " "

9. In this instance the comparative youth of the renewed bark does not permit me to quote so high a per-centage of alkaloids as that found some time since by Mr. Howard in bark that had been longer under treatment.* Nevertheless, the advantages of the mossing process applied to this bark, makes itself at once evident to the worker by the readiness and purity with which the sulphates crystallize. The amount of the latter would be much larger had sulphate of Chinchonidine been included.

10. An examination of the root bark of *C. Succirubra* enabled me to corroborate the statement of Dr. De Vrij that it contains a large amount of alkaloids.

The dried bark yielded—

Total alkaloids (hydrated).....	6.41 per cent.
Alkaloid soluble in Ether (Quinine)...	2.11 " "
Chinchonidine and Chinchonine...	3.8 " "
Crystallized sulphate of Quinine obtained...	2.6 " "

From the above it appears that the greater part of the alkaloids in this root-bark

Remarks on analyses. consists of Chinchonidine and Chinchonine. The former alkaloid occurs in considerable quantity. In no case, however, could the roots be a remunerative source of alkaloids, since their bark is thin, contains 4 per cent of water, and is laborious to procure.

11. The occurrence of alkaloids in the leaves of the *Chinchonæ* has been the subject of numerous and conflicting statements. In order

* Government Return, 1866, p. 124.

to enquire into this interesting and important point, I worked with four lbs. of the leaves of *C. Saccirubra*.* From these I succeeded in obtaining 3.1 grains of alkaloid, of which about 1 grain was soluble in ether, and gave a faint indication of Quinine when tested with Chlorine water and Ammonia. From none of the alkaloid obtained from the leaves was I able to obtain a definite crystalline sulphate or oxalate.

Though I would refrain from advancing a decisive opinion until I have examined the leaves at another period of the year, it appears to me to be probable, from the above examination, that the leaves of *C. Saccirubra* (even in the fresh green state) are worthless as a source of febrifuge alkaloids. They appear to owe their bitterness to the presence of Quinovin, a substance which may probably possess some tonic qualities.

12. Next to the *C. Saccirubra*, the most important species we at present possess is the *C. Officinalis*, whose varieties yield the Crown Barks. The three varieties *Bonplandiana*, *Urulusinga*, and *Crespilla*, greatly resemble one another, and appear to differ even less among themselves than some individuals of *C. Saccirubra*, of which Botanists recognize but one variety.

Of these varieties, *var Bonplandiana* is the most important, since upwards of 750,000 are now growing on the plantations. This variety also comprises the most advanced trees, whose identity with their name could be considered certain. The trunk bark of a tree from Dodabetta plantation yielded in the dry bark the following per-centages:—

Total alkaloids (hydrated)	3.6 per cent.
Analyses of Crown Bark. Alkaloid soluble in ether (Quinine)	2.8 " "
Chinchonine and Chinchonidine	0.8 " "
Sulphate of Quinine obtained crystallized. 2.5 " "	
The fresh bark contained 66 per cent. of water.	

* The method of proceeding adopted was as follows:—The bruised leaves were boiled in a chattie with water acidulated with Sulphuric Acid, and the bitter greenish decoction was separated by drainage and strong pressure through a cloth. It was then concentrated by evaporation, allowed to cool, and made strongly alkaline by the addition of milk of lime. A considerable precipitate was thus obtained, which was separated by filtration, and purified by careful washing; then dried at 200 F and powdered. This powder was then repeatedly boiled with strong spirit, and the alcoholic extracts evaporated to dryness. The residue consisted mainly of a bitter yellow resin. It was boiled with acidulated water (by which but a small proportion dissolved) and filtered. The solution was then made alkaline with Caustic Soda and shaken up in a separator with Chloroform. The Chloroform was then separated, and being evaporated by a gentle heat in a capsule, left the purified alkaloid as residue.

A second specimen of somewhat different habit yielded—

Total alkaloids (hydrated)	3.8 per cent.
Alkaloid soluble in Ether (Quinine) 3.0 " "	
Insoluble in Ether (Chinchonine) 0.8 " "	
Crystallized Sulphate of Quinine obtained	2.9 " "

Hence it appears that even at their present age the trees of *C. Officinalis var Bonplandiana* yield a bark of admirable quality, and nearly equal to the fine Calisaya bark of Bolivia. In the last quoted analysis no alkaloids were found, except Quinine and Chinchonine, the latter occurring in but small quantity. I am of opinion that this bark possesses, for manufacturing purposes, certain advantages over the Red Bark, that in some measure tend to compensate for the smaller yield and slower growth of the tree producing it. The Crown Bark yields its alkaloids with greater ease, owing to the small amount of resin and coloring matter with which they are associated.

13. An analysis of similar bark that had been renewed six months under moss yielded—

Mossed Crown Bark. Total alkaloids (hydrated)	6.8 per cent.
Alkaloid soluble in Ether (Quinine)	4.8 " "
Chinchonine and Chinchonidine	2.0 " "
Sulphate of Quinine obtained crystallized 4.1 " "	

This analysis shows that the mossaing process, though only applied for six months, has greatly increased the yield of alkaloids in this variety of bark.

14. I would here beg permission to state without advancing any new hypothesis, such known facts that appear in a great measure to explain the increased amount of alkaloids produced by mossaing the bark.

The injurious action of light on the Chinchona bark and alkaloids was clearly pointed out many years ago by Pasteur,* a Chemist, to whom

our present knowledge of these alkaloids is largely indebted. It is on account of this destructive action of light that he recommended shielding the bark from sun-light while drying. Pure colorless solutions of the alkaloids are soon colored brown and partially decomposed by exposure to sunshine. The same change takes place when dry or moist sulphate of Quinine is insolated.

*Comptes Rendus XXXVI. p. 26. and XXXVII. p. 162. Also Kopp's Jahresbericht 1853, p. 419.

15. In order to verify these facts in the climate of the Neilgherries, I prepared from Red Bark pure colorless solutions of each alkaloid and sealed them up *in vacuo* in glass tubes, in order to eliminate possible oxidation. After three days' exposure to the sun's rays they all became colored, while similar solutions preserved in the shade remained unaltered. The tube containing Quinine was opened after a fortnight's exposure, and its contents examined. It was then found that a considerable quantity of a dark colored resinous substance had been formed, and that much of the alkaloid had lost its power of crystallizing. I would submit that these circumstances are very significant, when applied to the elucidation of the cause of some of the changes occurring in the living bark, and are most suggestive of future experiments in the cultivation of the latter.

16. It has been stated that the action of the moss is to protect the alkaloids from oxidation. This is contradicted by the circumstance that moss does not prevent oxidation. Moss does not prevent oxidation. This is contradicted by the circumstance that moss not exclude either air or oxygen. It is also incompatible with the fact that the Quinidine produced under moss in *Micrantha* bark is really a more oxidized substance than the Chinchonine produced in the natural bark when fully exposed to the air.

17. It appeared to me that an examination of bark that had been renewed by natural processes, without the application of moss, would possess considerable interest. It was suggested by a statement in Howard's "Nueva Quinologia of Pavon," and also given on the authority of Ruiz.* I was able to obtain a small quantity of such renewed bark from two *Succirubra* trees which had been injured and partially stripped of their bark by the falling of a log in October 1864. The renewed bark was thicker than that of the natural bark, measuring 0.19 to 0.22 in., instead of 0.16 in., and had replaced itself mainly from the edges of the wound; not from the surface, as is the case in mossed bark, but its analysis gave but five per cent. of alkaloids, of which about 3.25 appeared to consist of Chinchonidine and Chinchonine. Unless, therefore, the effect had been impaired by the lapse of time or the character of the injury, the quality of this

renewed bark does not appear to corroborate the statement I have had the honor to cite above.

18. I would submit that the foregoing facts and considerations render it highly probable that the exposure of the living bark to direct sunlight, has the effect of diminishing the yield in alkaloids, and hence the advantage of direct protection.

I would beg leave to defer a comparative estimate of the respective values of the three varieties of *C. Officinalis* till a subsequent report.

19. An analysis of the bark taken from a plant of *C. Lancifolia*, two years' old, yielded 0.8 per cent. of alkaloids, in which (though but a very small amount of bark was at my disposal) I was able to obtain distinct traces of a crystalline sulphate.

20. An analysis of the trunk bark of *C. Micrantha*, of four and a half years' old, yielded the following numbers expressing per-centages in dry bark:—

Total alkaloids	7.1
Alkaloid soluble in Ether.....	0.3
Chinchonine.....	6.8
Crystalline Sulphates.....	None.

This large amount of Chinchonine crystallized from solution in alcohol with the greatest readiness and purity, forming splendid crystals 0.18 inches long. Huanuco bark contains usually only about 2.0 per cent. of alkaloid. Should Chinchonine come into use as a febrifuge (as appears not improbable from the experimental results of the Chinchona Commission,*) this *Micrantha* bark will furnish a most easy and abundant source. The tree reveals *C. Succirubra* in rapidity of growth, and the bark at present is 0.17 in. thick. It loses on drying 73 per cent. of water.

21. Nearly all the above analyses were made with the fresh undried bark of the trees. Some preliminary experiments showed me that the bark in the "green" condition presented several advantages which facilitate its examination for alkaloids. The latter are extracted with far greater ease from the fresh than from the dried and powdered bark; and with much less expenditure of acid and labour, and consequently with diminished risk of error or alteration in composition. I am of opinion that this property of the

* Nueva Quinologia. C. Uritsinga, p. 3.—"They cut off (Don Riofrio told me) the whole of the bark of the trunk of a small tree, leaving only a broad strip so as not to destroy the tree, which gradually replaces its loss; and the second time of cutting the bark is called *casearillas rescatas*, and esteemed of superior quality."

* Proceedings of the Madras Government. No. 302, 1867.

fresh bark will eventually become of considerable importance. For purposes of quotation, it is of course indifferent whether the analyses are conducted with the fresh or the dried bark, provided the process of drying be conducted with proper care.

22. I have communicated these and other results of my observations to Mr. McIvor, and have discussed with him various applications to future cultivation. I have had to thank Mr. McIvor for much kind assistance, and also for some valuable information concerning the plantations and their products.

23. I trust I may be pardoned for expressing my gratification at finding, from personal examination, that the Government Chinchona plantations offer in their present stage such unmistakeable indications of success.

24. I have the honor to forward by banghy four specimens of alkaloids prepared from Red Bark, and illustrative of the foregoing report.

REPORT OF AN ANALYSIS OF THE FIFTH REMITTANCE OF BARK FROM INDIA, BY J. E. HOWARD, Esq, F.L.S.

To the Under-Secretary of State for India.

February 4th, 1867.

SIR,—I have to report that the specimens of bark removed from trees in September and October 1866 reached me in good condition. The No. 1 specimen shows at once its superiority, and approaches nearly in appearance to the fine red bark grown in South America. No. 2 does not differ much at first sight, except in the absence of lichens, from No. 3. Amongst the barks of this parcel suited for sale at public auction, the broker at once selected the specimen of *C. Pahudiana*, as the most likely to give satisfaction, and as likely to realize at the present time from 1s. 6d. to 1s. 8d. per pound. Next to this, and at about the same value, comes No. 6, which is very much like the original specimen of this bark, as gathered by Mr. Cross, and now in my possession, together with a very well preserved specimen of a flowering branch of this sort, the *Colorada del Rey* of Pavon, and now named *C. Officinalis*, var. *Bonplandiana*. (See "Mr. Markham's Memorandum, at p. 5 of the Parliamentary Return (Chinchona) of June 18th, 1866.) I make this correction on the strength of the corresponding appearance with the specimen brought by Mr. Cross, and beg to direct particular attention to the discrimination of the varieties of *C. Officinalis*, which, though classed together in

some returns, and in others declared to be "not distinguishable," will be seen to be of totally different value for cultivation. Of this the *C. Officinalis*, var. *Crispa*, is a remarkable illustration. I pointed out in 1852 the great inferiority of produce in alkaloids of this, the "fine Loja bark" of modern commerce, to the original Loja barks. This characteristic is not altered by the new place of growth, and this sort also preserves its peculiarly black appearance, and its very crisp fracture, from which peculiarities it was called *Cascarilla crespilla negra* by the Spanish dealers. It is, however, no longer noted in its new place of growth for the aroma (compared by Professor Guibourt to that of tobacco), nor has it the same pleasing appearance as when grown on the mountains of Loja. It would fetch probably 1s. 4d. to 1s. 5d. per pound in the market. The remaining parcels would not at first command a ready sale, as they differ so widely in appearance from any now in the market.

The quantity sent this time, especially of the earlier numbers, was more favorable for examination, affording the opportunity of correction by a second or third analysis of any point left obscure, an opportunity which I should desire for a future re-examination of No. 6, though I do not suppose that the result would be more favorable than it is this time.

No. 1. *C. Succirubra*.—3rd crop of bark, renewed under moss,

Crystallized sulphates, per 100 parts	8.45
Alkaloids, soluble in ether, viz., chinchonidine and quinine	1.14
Insoluble in ether (chinchonicine)	0.20
	9.79

Memo.—The sulphates (of mixed quinine and chinchonidine) refine well, but do not stand the ether test.

No. 2. *C. Succirubra*.—Original bark, six months under moss.

Crystallized sulphates	4.57
Alkaloids soluble in ether, chinchonidine and quinine	3.78
Insol. in ether, chinchonine	0.80
Chinchonicine	0.11
	9.26

Memo.—The sulphates as No. 1, but less easily refined.

No. 3. *C. Succirubra*.—Original bark, unmossed.

Crystallized sulphates	4.50
Alkaloids soluble in ether	1.71
Insol. in ether, chinchonine prest. ..	0.40
Chinchonicine	0.34
	0.74
	6.95

Memo.—The sulphates as under No. 2.

No. 4. *C. Officinalis* var. *B. Condaminea* (*Bonplandiana*?).—Second crop of bark renewed under moss.

Crystallized sulphates	6.52
Alkaloids soluble in ether, quinine and chinchonidine	1.35
Insol. in ether, chinchonicine	0.15
	8.02

Memo.—The sulphate refines well, and stands the ether test.

No. 5. *C. Officinalis*, var. *B. Condaminea* (*Bonplandiana*?).—Original bark, nine months under moss.

Crystallized sulphates	6.66
Alkaloids soluble in ether, quinine and chinchonidine	0.56
Insol. in ether, chinchonicine	0.15
	7.37

Memo.—As No. 4.

No. 6. *C. Officinalis*, var. *B. Condaminea* (*Bonplandiana*?).—Original quill bark under moss.

Crystallized sulphates	2.58
Alkaloids soluble in ether, quinine and chinchonidine	2.10
Insol. in ether, chinchonicine	0.05
	4.73

Memo.—As No. 5.

No. 7. *C. Pakudiana*.—Original bark, nine months under moss.

Crystallized sulphates	0.581
Alkaloids soluble in ether, quinine chiefly. ..	0.180
Insol. in ether, chinchonicine, a trace	—
	0.761

Memo.—The quinine refined (with some loss) and separated from a very little chinchonidine (apparently) gave 0.580 per cent.

No. 8. *C. Officinalis*, var. *Crispa*.—Original bark unmossed.

Crystallized sulphates	0.259
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Alkaloids soluble in ether, chiefly quinine	0.370
Insol. in ether, chinchonicine, a trace	—
	0.629

Memo.—The quinine refined as above, still retaining a characteristic tinge of green, gave 0.590 per cent. Two specimens of this fine Loja in 1851 and 1854 gave me—

1854. A particularly fine and unmixed parcel—

Quinidine and uncrystallizable quinine	0.40
Chinchonine	0.03
	0.43

1851. Another parcel, slightly mixed with "rusty brown"—

Quinidine	0.57
Chinchonine	0.06
	0.63

(See Pereira's "Mat. Med." Vol. II., Part II. p. 1639, and "Pharmaceutical Journal," August 1854).

I trust that these trials will be useful in the guidance of the cultivation in India. It is evident that the plan adopted in No. 1 is the best. This was practised to some extent in the old times of collection of the Loja barks (as described by Ruiz in a M. S. in the British Museum, under the name of *Cascarillas resacas*), but unless the bark is covered with moss immediately, as discovered by Mr. M'Vior, the subjacent woody portion suffers serious injury. On the other hand, if this is attended to, the operation may be repeated with advantage, increasing, as it would seem, for every time of renewal. Not only is the gross percentage of alkaloids larger on the last decortication, but of this a more considerable per-centage consists of quinine, and that less intimately combined with the yellow colouring matter, so as to be more easily purified. The structure reminds of the granulated formation of flesh over a wound, and does not exhibit the customary liber fibres, or at least in a very much smaller proportion to the mass of the bark. This great richness in alkaloids does not seem to consist, therefore, with the views entertained by Wigand and others, that these liber fibres are the seat of the alkaloids. The improvement is less apparent in the present sample of the *C. Officinalis*, (No. 4), but it is probable that some slight alteration might add a large portion of the at present uncrystallized 1.35 per cent of alkaloid soluble in ether to the previous amount of crys-

tallized sulphates. In the meantime, the examination of No. 4 and No. 5 discloses a most gratifying success, in the excellencè of what I conclude to be the predominant variety cultivated in India.* It is only in very few instances that the best Bolivian bark approaches the good quality which this *Colorada del Rey* has already attained in India.

I have not yet had specimens for examination of the East Indian *C. Officinalis*, var. *Urutusinga*, but have reason to suppose this must also be a valuable species, whilst it must be evident that the var. *Crispa* should not be propagated, as it will not repay the expense of cultivation. The same remark, in my opinion, applies to the *C. Calisaya*, var. *Frutex* (as the sort hitherto chiefly cultivated is very properly named by Mr. M'Ivor†); also to the *C. Pahudiana*, which yields me much the same amount of alkaloid soluble in ether that it has done to Dr. De Vry. It is a pity to plant this sort; but where, as in Java, it is so extensively grown, it were equally a pity, as I think, not to turn the bark to some useful purpose in the way of decoctions.

I think the variety of *C. Officinalis*, which bore the name of *Cascarilla amarilla del Rey*, and which would now be *C. Officinalis*, var. *Bonplandiana lutea*,

* 753,272 plants out of 1,123,645 in May 1866. See "Report," p. 253.
† "Return," p. 233, &c.

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should also be introduced into the Indian cultivation. The bark of this sort fetches a high price in the market, as it is excellent for pharmaceutical preparations, and contains quinine in a very pure state.

It seems to me, that none of the small quill barks intended for sale to the druggists should be mossed, as the natural appearance of the bark would be more acceptable to the general dealer.

The effect of the application of moss for a few months to No. 2 does not show, as compared with the original unmossed bark of No. 3, so much real advantage as might have been expected. There is an increase in alkaloid, but this bears more upon the uncrystallizable portion of the quinine (as I ascertained by repeated experiment), and also upon the chinchonine, which was apparently doubled in the mossed bark at the expense of the chinchonicine. I cannot account for this fact, but perhaps Mr. M'Ivor may gain some light upon it.

The chinchonine in these two samples was obtained in a beautifully crystalline form as alkaloid, and afterwards in its characteristic crystallization as sulphate. Chinchonicine, the residuary product, insoluble in ether and of rather uncertain composition.

On the whole, the present remittance of barks is unquestionably the most instructive and the most encouraging that I have had the opportunity of examining from India.